Document Version: 0.1
Date: 2006/04/17

Product Functional Specification

19 inch WSXGA+ Color TFT LCD Module
Model Name: M190PW01 V0

(⊔) Preliminary Specification
(   ) Final Specification

Note: This Specification is subject to change without notice.

Ver 0.1

AU OPTRONICS CORPORATION

Product Specification

19"Wide SXGA⁺ Color TFT-LCD Module

Model Name: M190PW01 V.0

Approved by	Prepared by

DDBU Marketing Division / AU Optronics corporation

Customer	Checked & Approved by

Contents

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Record of Revision

Version and Date	Page	Old description	New Description	Remark
0.1 2006/04/17	All	First Edition for Customer	All	

1.0 Handling Precautions

1) Since front polarizer is easily damaged, pay attention not to scratch it.

2) Be sure to turn off power supply when inserting or disconnecting from input connector.

3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.

4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.

6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.

7) Do not open nor modify the Module Assembly.

8) Do not press or pat the panel surface by fingers,hand or tooling

9) Do not press the reflector sheet at the back of the module to any directions.

10) In case if a module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of the CCFL reflector edge. Instead, press at the far ends of the CCFL reflector edge softly. Otherwise the TFT module may be damaged.

11) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT module.

12) After installation of the TFT module into an enclosure (Desktop monitor Bezel, for example), do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT module from outside.   Otherwise the TFT module may be damaged.

2.0 General Description

This specification applies to the 19 inch-wide Color TFT-LCD Module M190PW01.

The display supports the WSXGA+ (1440(H) x 900(V)) screen format and 16.7M colors. All input signals are 2 Channel LVDS interface compatible.

This module does not contain an inverter card for backlight.

2.1 Display Characteristics

The following items are characteristics summary on the table under 25 ℃ condition:

ITEMS	Unit	SPECIFICATIONS
Active Area	[mm]	408.24 (H) x 255.15(V)
Pixels H x V		1440(x3) x 900
Pixel Pitch	[mm]	0.2835x 0.2835
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		TN Mode,Normally White
White Luminance (Center)	[cd/m^2]	300 cd/m2 @6.5mA (Typ)
Contrast Ratio		800 : 1 (Typ)
Optical Response Time	[msec]	5ms (Typ, on/off)
Color Saturation		72% NTSC
Nominal Input Voltage VDD	[Volt]	+5.0 V
Power Consumption (VDD line + CCFL line)	[Watt]	19.5W (Typ)
Weight	[Grams]	2500 (Typ)
Physical Size	[mm]	428.0(W) x 278.0(H) x 19.0(D) (Typ)
Electrical Interface		LVDS
Support Color		16.7M colors
Temperature Range Operating Storage (Shipping)	[^{o}C] [^{o}C]	0 to +50 -20 to +60
Surface Treatment		Hard-coating (3H)
RoHS		RoHS compliance

2.2 Optical Characteristics

The optical characteristics are measured under stable conditions at 25℃ :

Item	Unit	Conditions	Min.	Typ.	Max.	Note
Viewing Angle	[degree]	Horizontal (Right)+ (Left) CR = 10	150	160	- -	
	[degree]	Vertical (Up) + (Down) CR = 10	150	160	- -	
Contrast ratio		Normal Direction	600	800		
Response Time	[msec]	Raising Time	-	3.6	5.7	*Note 1*
	[msec]	Falling Time	-	1.4	2.3	*Note 1*
	[msec]	Rising + Falling	-	5	8	*Note 1*
Color / Chromaticity Coordinates (CIE)		Red x	0.61	0.64	0.67	
		Red y	0.32	0.35	0.38	
		Green x	0.26	0.29	0.32	
		Green y	0.59	0.62	0.65	
		Blue x	0.11	0.14	0.17	
		Blue y	0.04	0.07	0.1	
Color Coordinates (CIE) White		White x	0.28	0.31	0.34	
		White y	0.3	0.33	0.36	
White Luminance at CCFL 6.5mA (central point)	[cd/m^2]		250	300	-	
Luminance Uniformity	[%]		75	80	-	*Note 2*
Crosstalk (in75Hz)	[%]				1.5	*Note 3*
Flicker	DB				-20	*Note 4*

Equipment:　　Pattern Generator, Power Supply, Digital Voltmeter, Luminance meter (PR 880, BM-5A ,

　　　　　　　BM 7 ,CS-1000, & EZContrast*)

Aperture　:　　1° with 100cm viewing distance (VD) or 2° with 50cm viewing distance (VD)
Test Point:　　Center (VESA point 9)
Environment:　< 1 lux
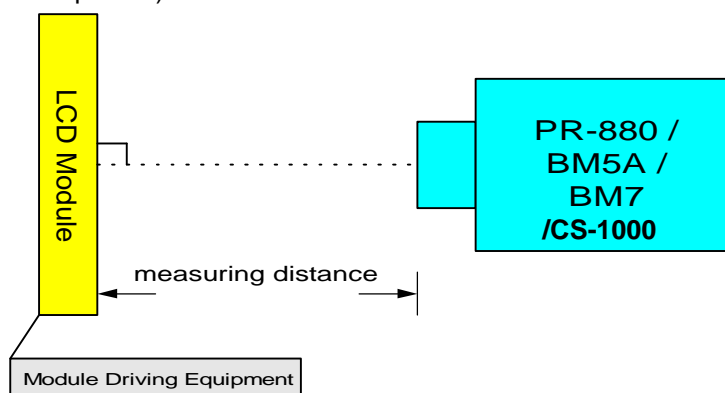
*' EZ Contrast is different measurement tool with very close viewing distance.

***Note 1:* Definition of Response time**

The output signals of photo detector are measured when the input signals are changed from "Black" to "White" (risir time), and from "White" to "Black "(falling time), respectively. The response time is interval between the 10% ar 90% of amplitudes.
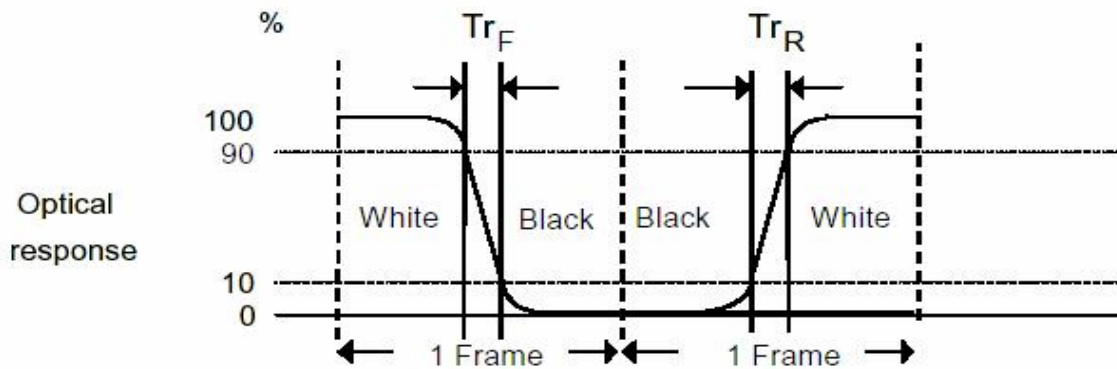
***Note 2:* Brightness uniformity of these 9 points is defined as below**
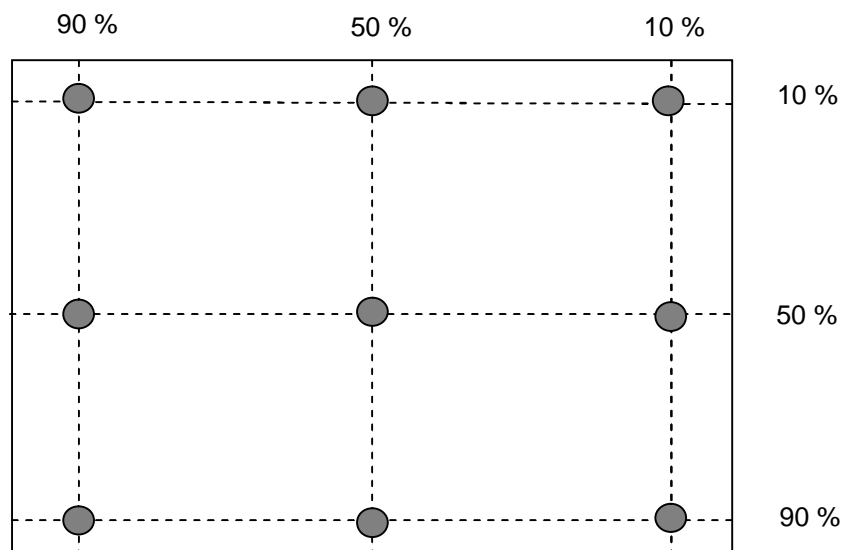
$$\text{Uniformity} = \frac{\text{Minimum Luminance in 9 points (1-9)}}{\text{Maximum Luminance in 9 Points (1-9)}} \times 100\%$$

Note 3: Crosstalk is defined as below :

Unit: percentage of dimension of display area

l L_A-$L_{A'}$ l / L_A x 100%= 1.5% max., L_A and L_B are brightness at location A and B

l L_B-$L_{B'}$ l / L_B x 100%= 1.5% max., $L_{A'}$ and $L_{B'}$ are brightness at location A' and B'

Note 4: Test Paterm: Subchecker Pattern

Gray Level = L127

Gray Level = L0
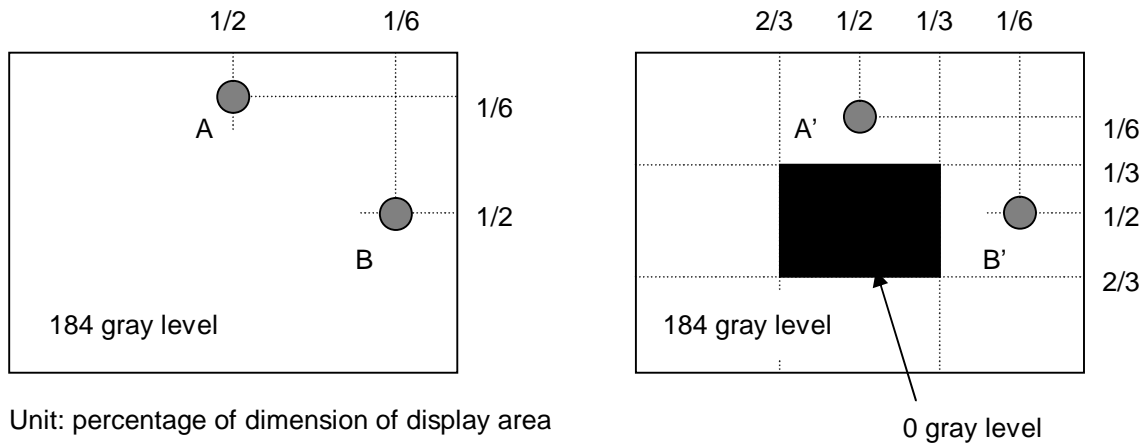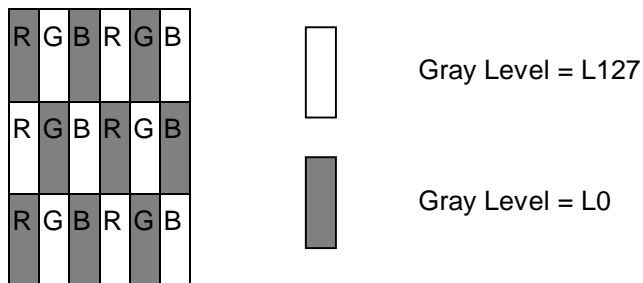
Method: Record dBV & DC value with (WESTAR)TRD-100
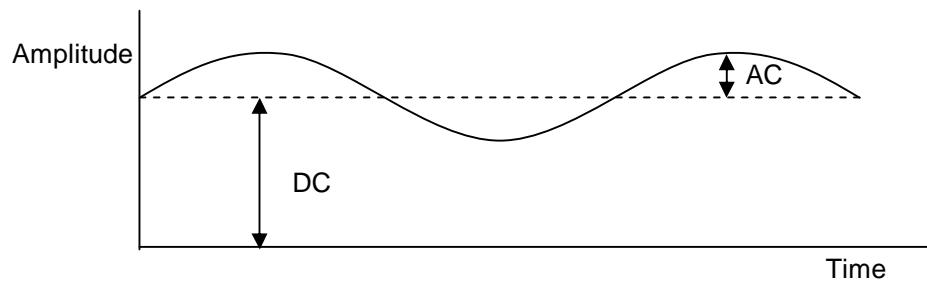
$$\text{Flicker (dB)} = 20\log\frac{\text{AC Level(at 30 Hz)}}{\text{DC Level}}$$

3.0 Functional Block Diagram

The following diagram shows the functional block of the 19 inches wide Color TFT/LCD Module:

AUO ASIC

LVDS

+ 5V

Connector

LVDS Receiver

Timing Controller

G1

TFT-LCD
1440*(3)*900
Pixels

G900

D1   D4320

4 CCFL

DC/DC Converter

Gamma Correction

I/F + X-PCB

DC POWER

Inverter
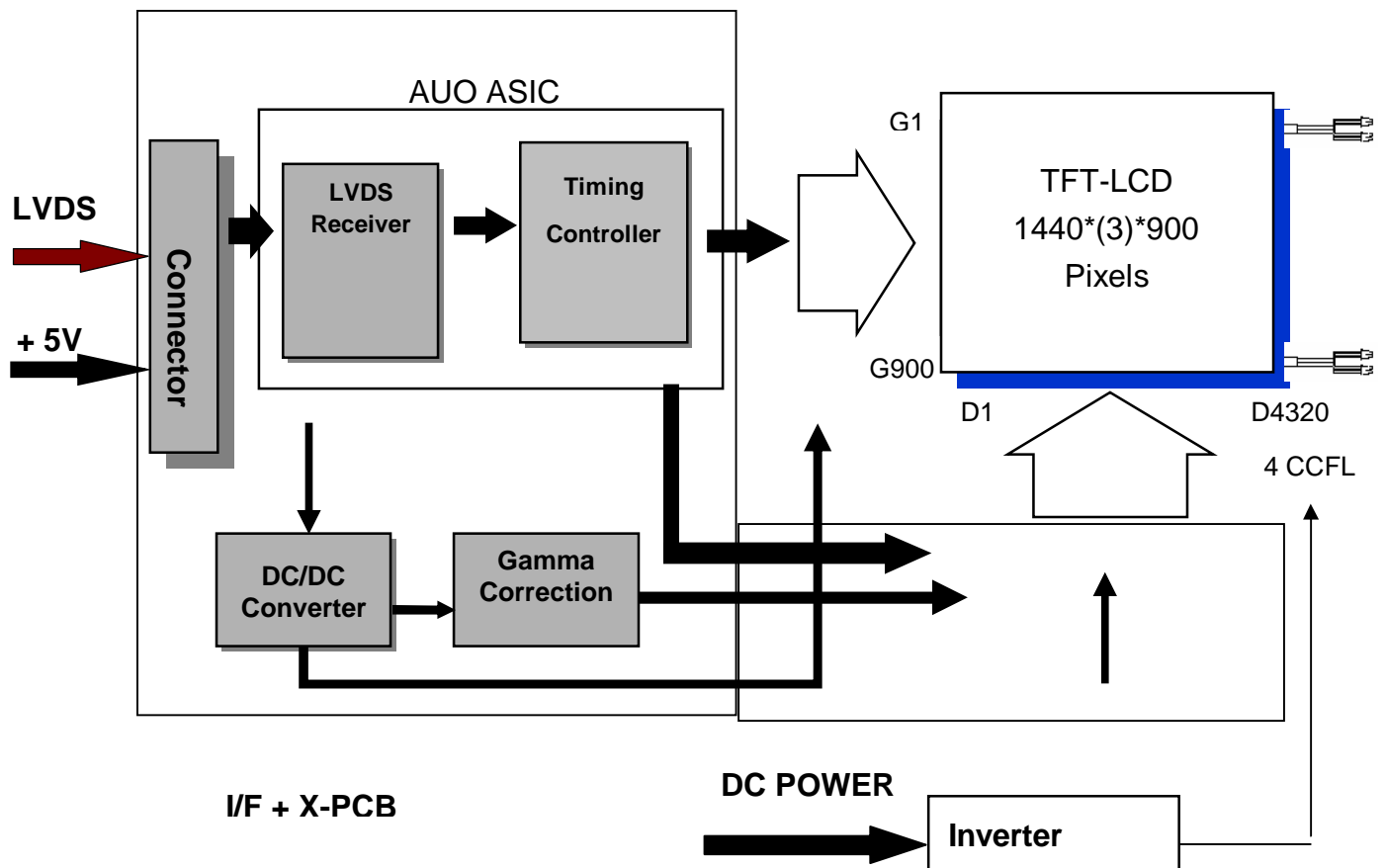
JAE FI-XB30SSL-HF15

Mating Type: FI-X30HL

JST BHSR-02VS-1

Mating Type: SM02B-BHSS-1-TB

4.0 Absolute Maximum Ratings

Absolute maximum ratings of the module is as following:

4.1 TFT LCD Module

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive	VIN	-0.3	+5.5	[Volt]	*Note 1,2*

4.2 Backlight Unit

Item	Symbol	Min	Max	Unit	Conditions
CCFL Current	ICFL	-	8	[mA] rms	*Note 1,2*

4.3 Absolute Ratings of Environment

Item	Symbol	Min	Max	Unit	Conditions
Operating Humidity	HOP	5	95	[%RH]	*Note*
Storage Temperature	TST	-20	+60	[^{o}C]	*Note*
Storage Humidity	HST	8	95	[%RH]	*Note*

Note 1: With in Ta (25℃)

Note 2: Permanent damage to the device may occur if exceed maximum values

Relative Humidity %

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Temperature C
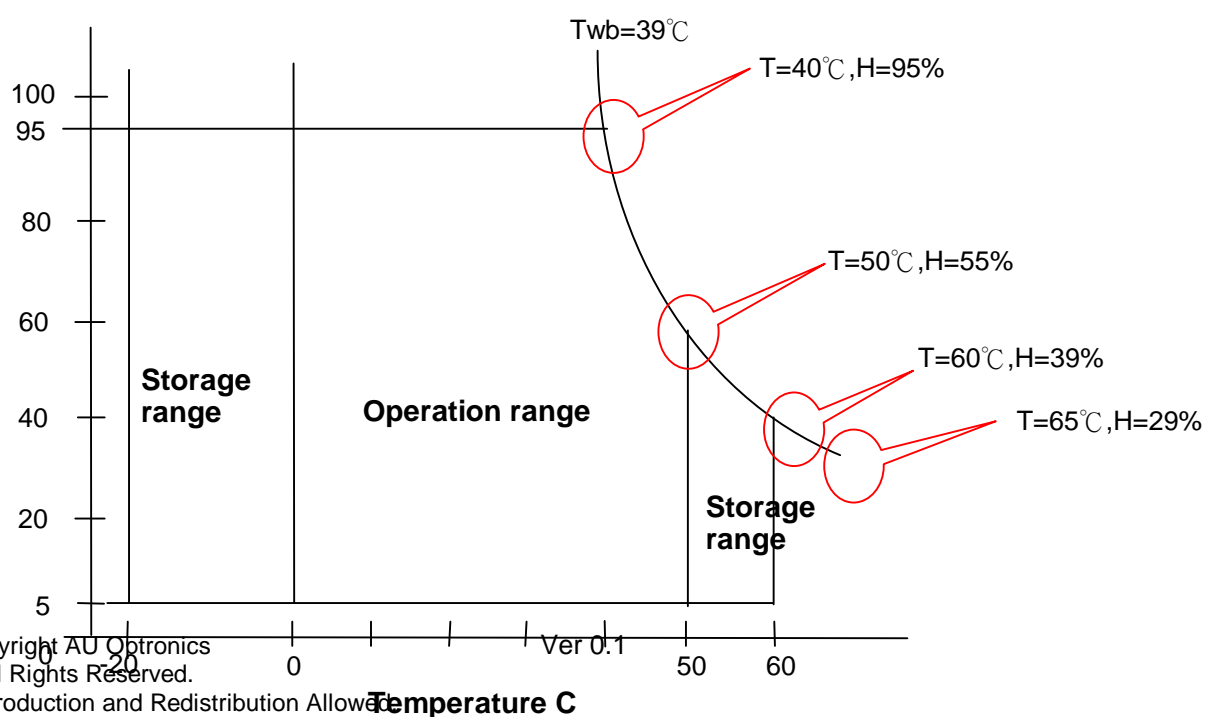
5.0 Electrical characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

Input power specifications are as follows;

Symbol	Parameter	Min	Typ	Max	Units	Condition
VDD	Logic/LCD Drive Voltage	4.5	5	5.5	[Volt]	±10%
IDD	VDD current	-	1500	1900	[mA]	Vin=5V, All Black Pattern, +30%, at frame rate 75Hz
Irush	LCD Inrush Current	-	-	2.5	[A]	*Note*
PDD	VDD Power		7.5	9.75	[Watt]	Vin=5V, All Black Pattern +30%, at frame rate 75Hz
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			100	[mV] p-p	
VDDns	Allowable Logic/LCD Drive Ripple Voltage			100	[mV] p-p	

Note: Measurement conditions:
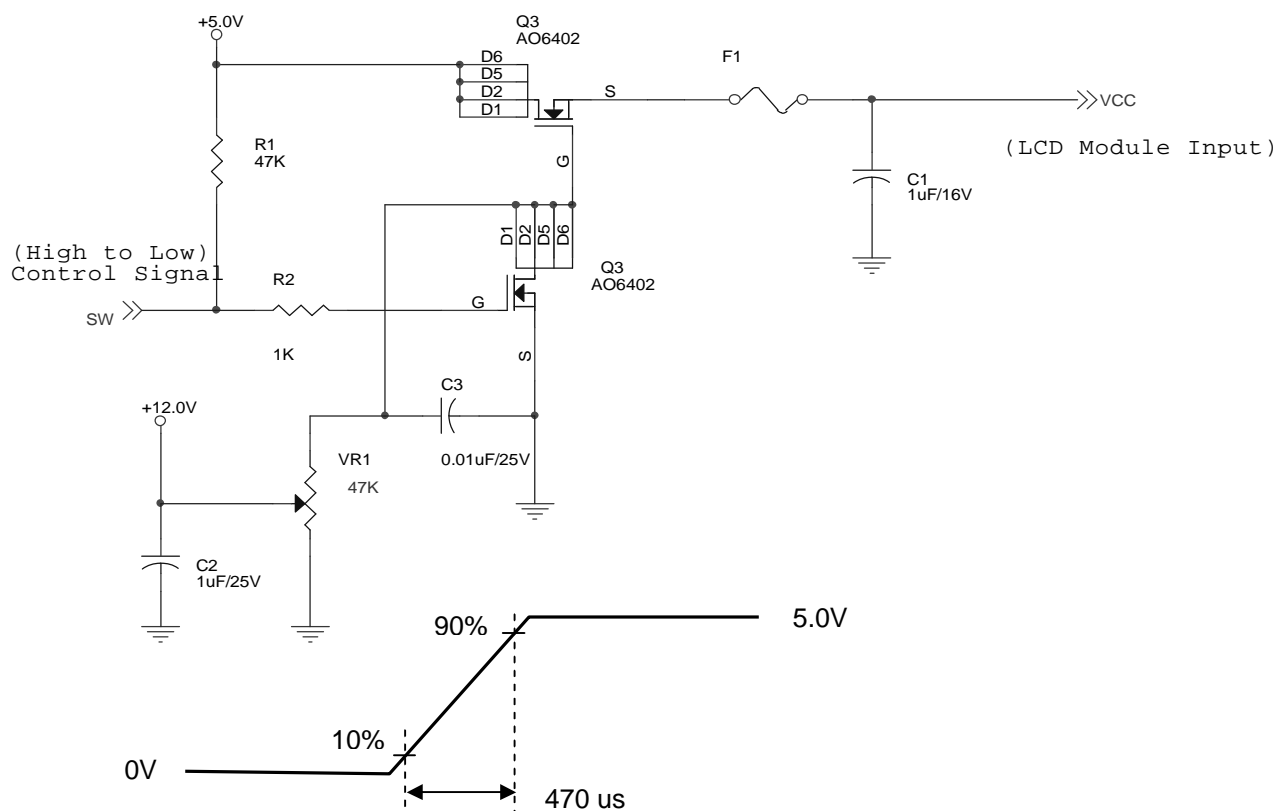
Vin rising time

5.1.2 Signal Electrical Characteristics

Input signals shall be low or Hi-Z state when Vin is off
It is recommended to refer the specifications of SN75LVDS82DGG (Texas Instruments) in detail.

Each signal characteristics are as follows;

Symbol	Parameter	Min	Typ	Max	Units	Condition
VTH	Differential Input High Threshold	-	-	+100	[mV]	VICM = 1.2V **Note**
VTL	Differential Input Low Threshold	-100	-	-	[mV]	VICM = 1.2V **Note**
｜VID｜	Input Differential Voltage	100	400	600	[mV]	**Note**
VICM	Differential Input Common Mode Voltage	+1.0	+1.2	+1.5	[V]	VTH/VTL = ±100MV **Note**

Note: LVDS Signal Waveform
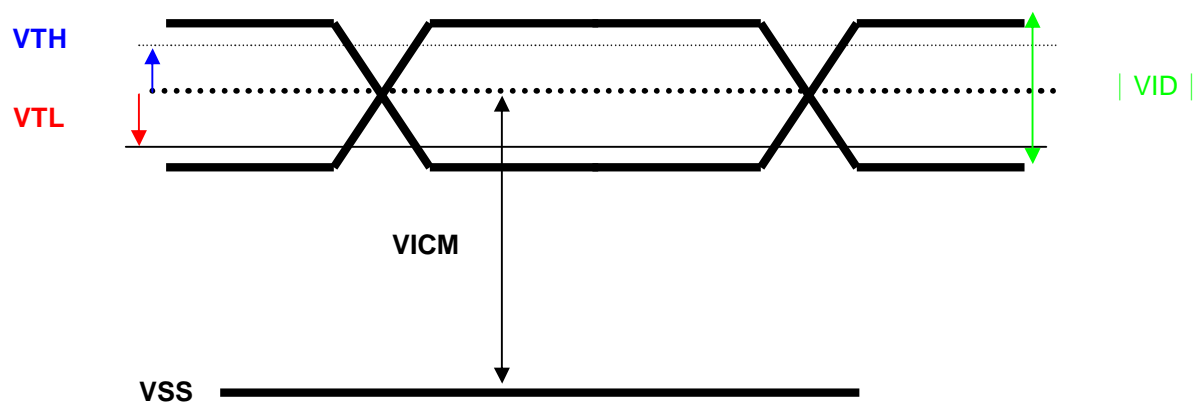
5.2 Backlight Unit

Parameter guideline for CCFL Inverter

Symbol	Parameter	Min.	Typ.	Max.	Unit	Condition
ISCFL	CCFL standard current	6.0	6.5	7.0	[mA] rms	(Ta=25°C) *Note 1*
IRCFL	CCFL operation range	3.0	6.5	8.0	[mA] rms	(Ta=25°C)
FCFL	CCFL Frequency	40	50	80	[KHz]	(Ta=25°C) *Note 2*
ViCFL (0°C)	CCFL Ignition Voltage (**End of the lamp wire connector**)	1700	-		[Volt] rms	(Ta=0°C) *Note 3*
ViCF (25°C)	CCFL Ignition Voltage (**End of the lamp wire connector**)	1200	-		[Volt] rms	(Ta=25°C) *Note 3*
VCFL	CCFL Operation Voltage		720 @6.5mA		[Volt] rms	(Ta=25°C) *Note 4*
PCFL	CCFL Power consumption (for reference)	-	19.6	22	[Watt]	(Ta=25°C) *Note 5*
LTCFL	CCFL life Time	40,000	50,000	-	[Hour]	(Ta=25°C) *Note 6*

Note 1: CCFL standard current is measured at 25±2℃.

Note 2: CCFL Frequency should be carefully determined to avoid interference between inverter and TFT LCD

Note 3: ViCFL means Ignition Voltage for both ends of the lamp, and CCFL inverter should be able to give out a power that has a generating capacity of over ViCFL for ignition

Note 4: CCFL operation voltage is measured at 25±2℃.

Note 5: The variance of CCFL power consumption is ±10%. Power is calculated for reference (ICFL×VCFL×4=PCFL).

Note 6: Definition of life: brightness becomes 50% or less than the minimum luminance value of CCFL. The typical life time of CCFL is on the condition at 7.0 mA lamp current.

6.0 Signal Characteristic

6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.
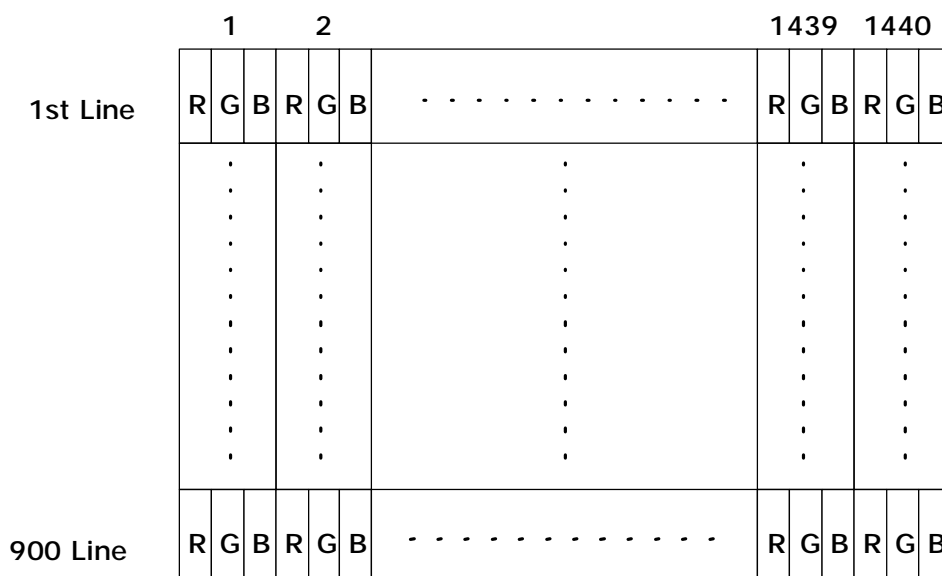
6.2 The input data format
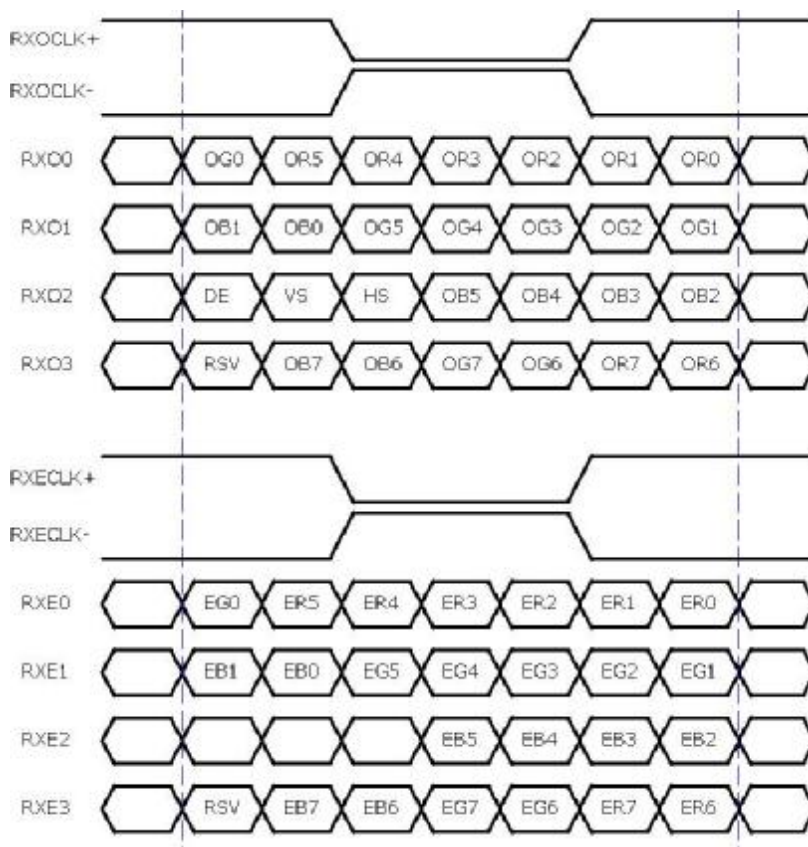
Note 1: R/G/B data 7:MSB, R/G/B data 0:LSB

O = "First Pixel Data"

E = "Second Pixel Data"

6.3 Signal Description

The module using one LVDS receiver SN75LVDS82(Texas Instruments) or compatible. LVDS is a differential signal technology for LCD interface and high speed data transfer device. Transmitter shall be SN75LVDS83(negative edge sampling) or compatible. The first LVDS port(RxOxxx) transmits odd pixels while the second LVDS port(RxExxx) transmits even pixels.

| PIN #	SIGNAL NAME	DESCRIPTION
1	RxO0-	Negative LVDS differential data input (Odd data)
2	RxO0+	Positive LVDS differential data input (Odd data)
3	RxO1-	Negative LVDS differential data input (Odd data)
4	RxO1+	Positive LVDS differential data input (Odd data)
5	RxO2-	Negative LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
6	RxO2+	Positive LVDS differential data input (Odd data, H-Sync,V-Sync,DSPTMG)
7	GND	Power Ground
8	RxOC-	Negative LVDS differential clock input (Odd clock)
9	RxOC+	Positive LVDS differential clock input (Odd clock)
10	RxO3-	Negative LVDS differential data input (Odd data)
11	RxO3+	Positive LVDS differential data input (Odd data)
12	RxE0-	Negative LVDS differential data input (Even clock)
13	RxE0+	Positive LVDS differential data input (Even data)
14	GND	Power Ground
15	RxE1-	Negative LVDS differential data input (Even data)
16	RxE1+	Positive LVDS differential data input (Even data)
17	GND	Power Ground
18	RxE2-	Negative LVDS differential data input (Even data)
19	RxE2+	Positive LVDS differential data input (Even data)
20	RxEC-	Negative LVDS differential clock input (Even clock)
21	RxEC+	Positive LVDS differential clock input (Even clock)
22	RxE3-	Negative LVDS differential data input (Even data)
23	RxE3+	Positive LVDS differential data input (Even data)
24	GND	Power Ground
25	NC	No contact (For AUO test only)
26	NC	No contact (For AUO test only)
27	NC	No contact (For AUO test only)
28	POWER	Power
29	POWER	Power
30	POWER	Power

Note1: Start from left side

Connector

1   30

RxOIN0-   VCC
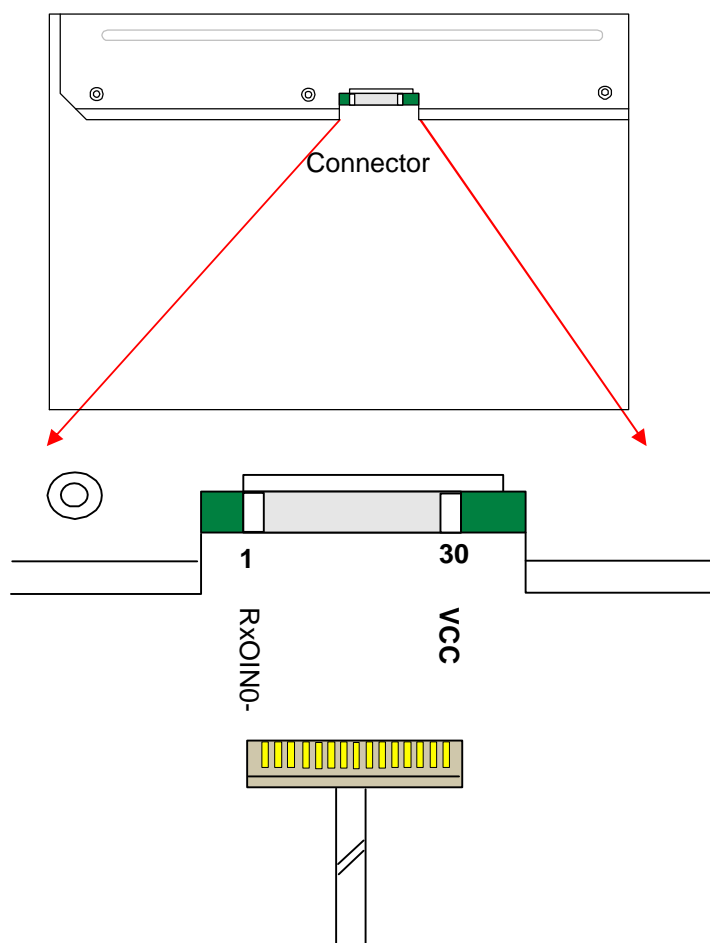
Note2: Input signals of odd and even clock shall be the same timing.

6.4 Timing Characteristics

Basically, interface timings described here is not actual input timing of LCD module but output timing of SN75LVDS82DGG (Texas Instruments) or equivalent.

Signal	Item	Symbol	Min	Typ	Max	Unit
Vertical Section	Period	Tv	910	916	2048	Th
	Active	Tdisp(v)	900	900	900	Th
	Blanking	Tbp(v)+Tfp(v)+PWvs	10	16	1148	Th
Horizontal Section	Period	Th	760	864	2048	Tclk
	Active	Tdisp(h)	720	720	720	Tclk
	Blanking	Tbp(h)+Tfp(h)+PWhs	40	144	1328	Tclk
Clock	Period	Tclk	22.2	21.1	15.4	ns
	Frequency	Freq	45	47.5	64	MHz
Frame rate	Frame rate	F	55	60	75	Hz

Note : DE mode only

6.4.1 Timing diagram
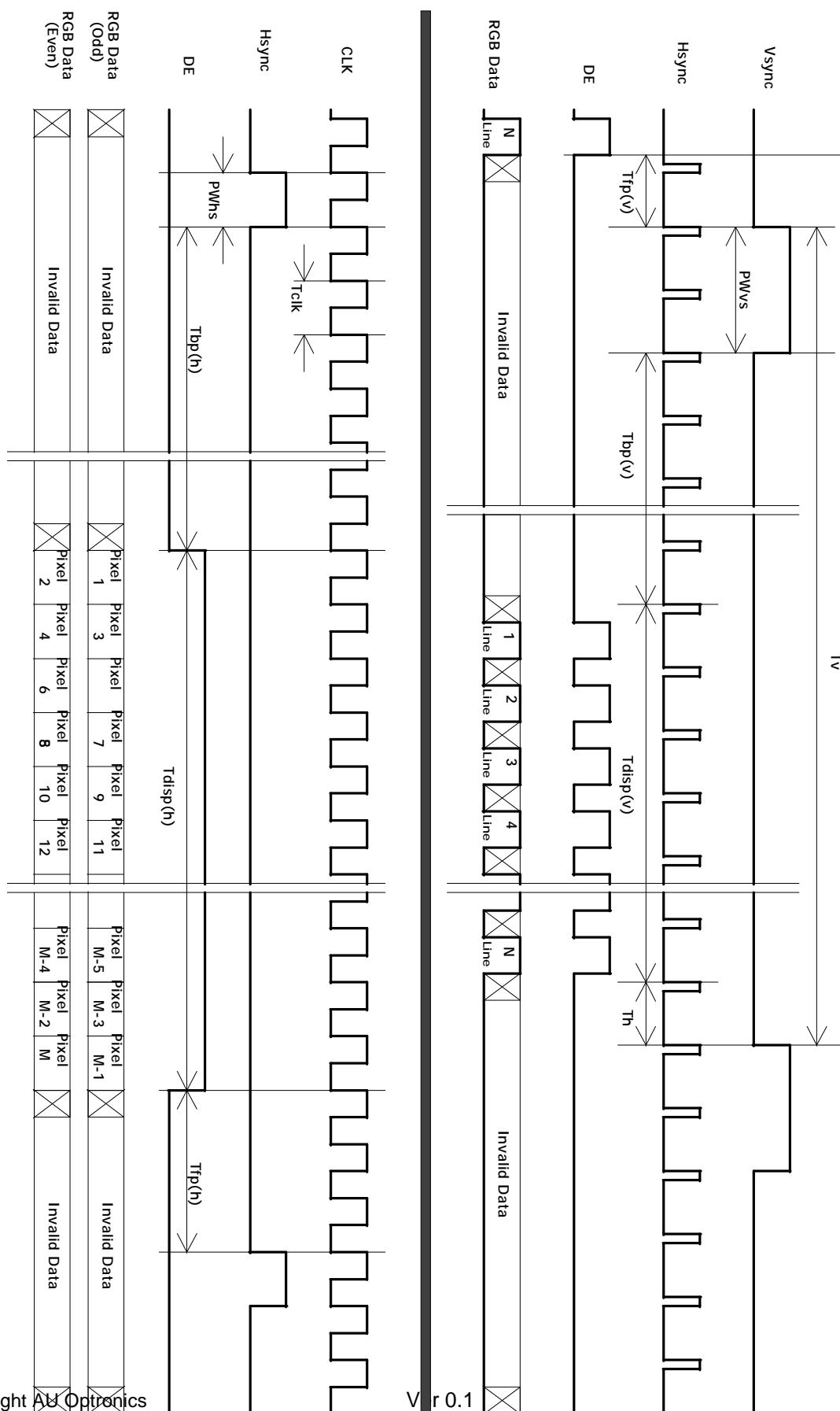
6.5 Power ON/OFF Sequence

Vin power and lamp on/off sequence is as follows. Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when Vin is off.
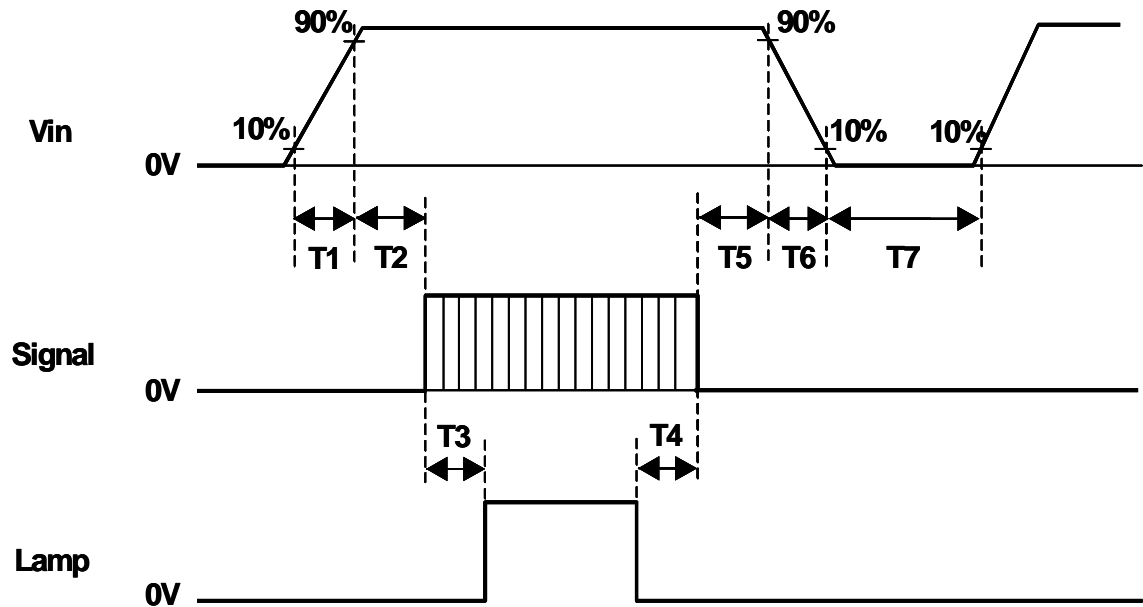
Symbol	Values			Unit
	Min	Typ	Max	
T1	0.5	-	10	[ms]
T2	0.5	40	50	[ms]
T3	200	-	-	[ms]
T4	200	-	-	[ms]
T5	0.5	16	50	[ms]
T6	-	-	10	[ms]
T7	1000	-	-	[ms]

7.0 Connector & Pin Assignment

Physical interface is described as for the connector on module.
These connectors are capable of accommodating the following signals and will be following components.

7.1 TFT LCD Module

Connector Name / Designation	Interface Connector / Interface card
Manufacturer	JAE or compatible
Type Part Number	FI-XB30SSL-HF15
Mating Housing Part Number	FI-X30HL-T (Locked Type) FI-X30S-H (Unlocked Type) or equivalent

Pin#	Signal Name	Pin#	Signal Name
1	RxO0-	2	RxO0+
3	RxO1-	4	RxO1+
5	RxO2-	6	RxO2+
7	GND	8	RxOC-
9	RxOC+	10	RxO3-
11	RxO3+	12	RxE0-
13	RxE0+	14	GND
15	RxE1-	16	RxE1+
17	GND	18	RxE2-
19	RxE2+	20	RxEC-
21	RxEC+	22	RxE3-
23	RxE3+	24	GND
25	NC	26	NC
27	NC	28	Power
29	Power	30	Power

7.2 Backlight Unit

Connector Name / Designation	Lamp Connector / Backlight lamp
Manufacturer	YEON HO
Type Part Number	35001HS-02L
Mating Type Part Number	35001WR-02LP or equivalent

7.3 Signal for Lamp connector

	Connector No.	Pin No.	Color	Function
Upper	CN1	1	Blue	High Voltage (Lamp 1)
		2	Black	Low Voltage (Lamp 1)
	CN2	1	Pink	High Voltage (Lamp 2)
		2	White	Low Voltage (Lamp 2)
Lower	CN3	1	Blue	High Voltage (Lamp 3)
		2	Black	Low Voltage (Lamp 3)
	CN4	1	Pink	High Voltage (Lamp 4)
		2	White	Low Voltage (Lamp 4)

8.0 Reliability

Reliability test condition

No	Test Item	Test Condition
1	Temperature Humidity Bias (THB)	50℃, 80%, 300hours
2	High Temperature Operation (HTO)	50℃, 300hours
3	Low Temperature Operation (LTO)	0℃, 300hours
4	High Temperature Storage (HTS)	60℃, 300hours
5	Low Temperature Storage (LTS)	-20℃, 300hours
6	Thermal Shock Test (TST)	-20℃/30min, 60℃/30min, 100 cycles
7	On/Off Test	On/10sec, Off/10sec, 30,000 cycles
8	Shock Test (Non-Operating)	50G, 20ms, Half-sine wave ($\pm$ X, $\pm$Y, $\pm$Z)
9	Vibration Test (Non-Operating)	1.5G(10~200Hz P- P), 30 Minutes each Axis (X, Y, Z)
10	ESD (ElectroStatic Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω) 1sec, 8 points, 25 times/ point Air Discharge: ± 15KV, 150pF(330Ω) 1sec, 8 points, 25 times/ point
11	Altitude Test	Operation:10,000 ft Non-Operation:30,000 ft

9.0 Environment

The display module will meet the provision of this specification during operating condition or after storage or shipment condition specified below. Operation at 10% beyond the specified range will not cause physical damage to the unit.

9.1 Temperature and Humidity

9.1.1 Operating Conditions

The display module operates error free, when operated under the following conditions;
Temperature $0\,^0C$ to $50\,^0C$
Relative Humidity   8% to 95%
Wet Bulb Temperature $39.0\,^0C$

9.1.2 Shipping Conditions

The display module operates error free, after the following conditions;
Temperature $-20\,^0C$ to $60\,^0C$
Relative Humidity   8% to 95%
Wet Bulb Temperature $39.0\,^0C$

9.2 Atmospheric Pressure

The display assembly is capable of being operated without affecting its operations over the pressure range as following specified;

	Pressure	**Note**
Maximum Pressure	1040hPa	0m = sea level
Minimum Pressure	674hPa	3048m = 10.000 feet

Note : Non-operation attitude limit of this display module = 30,000 feet. = 9145 m.

9.3 Thermal Shock

The display module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20^0C to 60^0C, and back again.

Thermal shock cycle $-20\,^0C$ for 30min
                                  $60\,^0C$ for 30min

Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before powering on.

10.0 Reliability

This display module and the packaging of that will comply following standards.

10.1 Failure Criteria

The display assembly will be considered as failing unit when it no longer meets any of the requirements stated in this specification. Only as for maximum white luminance, following criteria is applicable.

l   Maximum white Luminance shall be 125cd/m^2 or more.

10.2 Failure Rate

The average failure rate of the display module (from first power-on cycle till 1,000 hours later) will not exceed 1.0

The average failure rate of the display module from 1,000 hours until 16,000 hours will not exceed 0.7% per 1000

hours.

10.2.1 Usage

The assumed usage for the above criteria is:
- l   220 power-on hours per month
- l   500 power on/off cycles per month
- l   Maximum brightness setting
- l   Operation to be within office environment (25^{0}C typical)

10.2.1 Component De-rating

All the components used in this device will be checked the load condition to meet the failure rate criteria.

10.3 On/OFF Cycle

The display module will be capable of being operated over the following ON/OFF Cycles.

ON/OFF	Value	Cycles
+Vin and CCFL power	30,000	10 seconds on / 10 seconds off

11.0 Safety

11.1 Sharp Edge Requirements

There will be no sharp edges or comers on the display assembly that could cause injury.

11.2 Materials

11.2.1 Toxicity

There will be no carcinogenic materials used anywhere in the display module. If toxic materials are used, they will be reviewed and approved by the responsible ADT Toxicologist.

11.2.2 Flammability

All components including electrical components that do not meet the flammability grade UL94-V1 in the module will complete the flammability rating exception approval process.

The printed circuit board will be made from material rated 94-V1 or better. The actual UL flammability rating will be printed on the printed circuit board.

11.3 Capacitors

If any polarized capacitors are used in the display assembly, provisions will be made to keep them from being inserted backwards.

12.0 Other requirement

12.1 National Test Lab Requirement

The display module will satisfy all requirements for compliance to

UL 1950, First Edition	U.S.A. Information Technology Equipment
CSA C22.2 No.950-M89	Canada, Information Technology Equipment
EEC 950	International, Information Technology Equipment
EN 60 950	International, Information Processing Equipment
	(European Norm for IEC950)

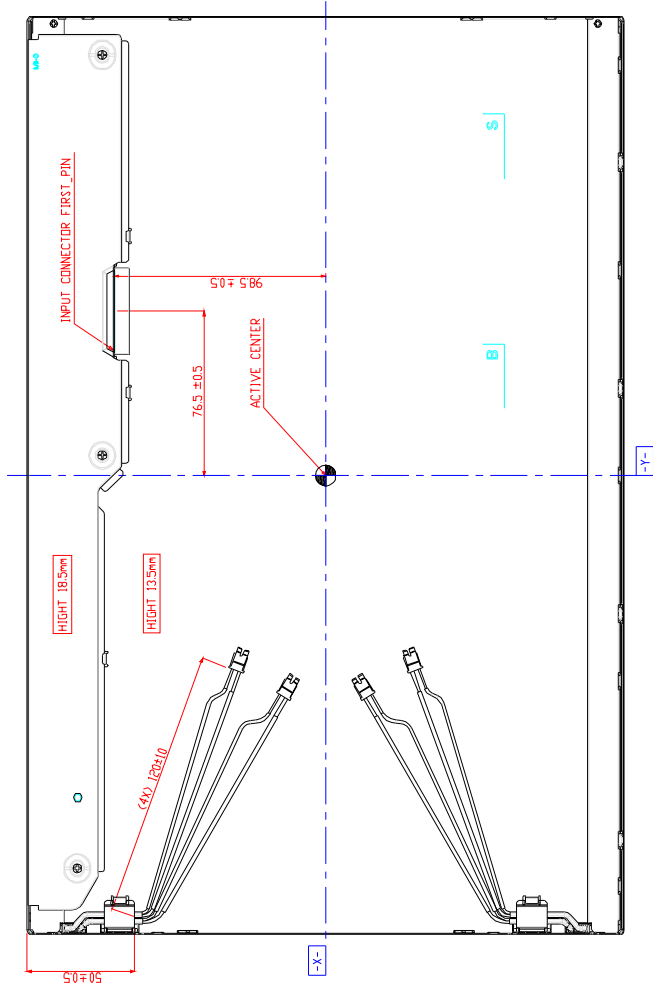## 12.2 Label

The label is on the panel as shown below: (TBD)

13.0 Mechanical Characteristics

Please refer to the next 2 pages.

NOTE :
1. TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA AS FOLLOWS:
   (1) Y-DIRECTION : |A-B| <= 1.0mm
   (2) X-DIRECTION : |C-D| <= 1.0mm
2. TORQUE OF (4X) M3 USER HOLE BOSS SHOULD BE WITHIN 4 kg-cm AND RE-SCREW 10 TIMES.
3. I/F CONNECTOR :
   FI-XB30SSL-HF15 (JAE) OR EQUIVALENT.
4. LAMP CONNECTOR :
   35001HS-02L (YEON HO) OR EQUIVALENT.

APPEARANCE DRAWING
AU Optronics

18.5±0.5
(2X) 7.85 ±0.3
(49)
98±0.3
90±0.3
278±0.5
255.15 BEZEL OPEN
255.15 ACTIVE AREA
7.9
9.4
(214)
ACTIVE CENTER
428±0.5 BEZEL OPEN
412.24 ACTIVE AREA
408.24 ACTIVE AREA
(139)
-X-
-Y-
-X-

SEE DETAIL A
SECTION A-A

A
B
C
D

(4X) M3 USER HOLE
DP = 4.2mm MAX SCREW PENETRATION.
90±0.3
98±0.3
(49)
(2X) 7.85 ±0.3
-X-

0.2
0.3
2.4

DETAIL A
SCALE 8.000

INPUT CONNECTOR FIRST_PIN

98.5 ±0.5

76.5 ±0.5

ACTIVE CENTER

HIGHT 18.5mm

HIGHT 13.5mm

(4X) 120±10

50±0.5

-Y-

-Y-

-X-

S

B